

**31B Gambell Wind Generation Project**  
**Final Closeout Summary**  
**March 14, 2011**

This Final Closeout Summary Report is filed with the federal grantor agency the Denali Commission (“Denali” or “DC”) by the grantee partner Alaska Village Electric Cooperative, Inc. (“AVEC”). The federal grant awards affected by this report and by this project are: 0049-DC-2002-I2 and 349-07.

An initial project closeout report entitled “Award Transition and Closeout Summary” was submitted for this project on June 16, 2009. At the time, the project was still in construction under an active Denali award, 349-07. That initial, transitional closeout report was submitted because funds allocated to this project from the earlier Denali Commission award 0049-DC-2002-I2 had been fully expended, and the award had expired and was being closed. This final closeout report is now being filed because the project is complete, and award 349-07 has also expired and is being closed. Federal funds in the amount of \$116,613 are now available for de-obligation from award 349-07.

The following report represents the project status as of December 31, 2010.

**Background** - Gambell is located on the northwest cape of St. Lawrence Island, 200 miles southwest of Nome, in the Bering Sea. It lies 39 miles northwest of Savoonga, its neighboring St. Lawrence Island community. The community is 38 miles from the Chukotsk Peninsula, Siberia. Gambell has a second class city government, a population of 662, and lies at approximately 63.779720° North Latitude and -171.741110° West Longitude (Sec. 03, T020S, R067W, Kateel River Meridian). Gambell is located in the Cape Nome Recording District. Gambell has a subarctic maritime climate with continental influences in the winter. Winds and fog are common, and precipitation occurs 300 days per year. Average annual precipitation is 15 inches, including 80 inches of snowfall. The island is subject to prevailing winds averaging 18 mph. The Bering Sea freezes during mid-November, with break-up at the end of May. Average summer temperatures are 34 to 48; average winter temperatures are -2 to 10. Extremes from -30 to 65 have been recorded.

**Activities** - The main objective of this project is to generate electricity from a local renewable resource in an effort to reduce the local dependency on fuel oil as the sole source for electric power generation. All work described hereunder was accomplished by this project, except as noted. Project scope included planning, design, construction and commissioning of 3 new 100kW capacity wind turbines, a fiber optic communications link, and a secondary load system, at a site adjacent to the Gambell AVEC power plant and tank farm. The wind generators’ output will augment the prime source generation provided by the new diesel-powered modular power plant which was recently separately installed under Denali project 31D.

The conical steel towers supporting the wind turbine generators are 30 meters tall. They are attached to reinforced concrete pad foundations embedded into the native rounded cobble stone base, which are designed to counteract the overturning moment forces from wind and vibration.

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Each of the concrete foundations has a 24 ft x 24ft x 4 ft base and pedestal and contains approximately 115 cubic yards of concrete. The new wind turbines were connected to the new diesel power plant (completed in 2006 under Denali project 31D) via a new three-phase primary distribution line, built under Denali project 31H during the same time as the wind turbine project. Installation of a fiber optic communications link provides communication between the wind turbines and the control module installed in the new power plant, and this combined system allows the wind turbines to be either manually or automatically operated both at the power plant and from AVEC headquarters in Anchorage, maximizing operational stability and allowing remote trouble shooting in the event of alarms or warnings. The control module at the new power plant also houses electronic diesel engine controls and fully automated switchgear that achieve a seamless integration of the energy produced by the wind turbines, which is intermittent in nature, into the reliable, on-demand stream of energy provided by the power plant's diesel generators.

In addition to these components, the system is fitted with a secondary load system comprised of a 265 kW electric water heater and related controls and switching relays that serve as a “dump load” for the wind turbines. This system will absorb excess electrical energy during those periods when wind turbine output exceeds the community load, transferring the excess energy as heat to the AVEC power plant in the near term, and potentially to other building(s) that may be added to the heat transfer circuit from the AVEC power plant in the future. Taken together, these control systems – wind turbine controls, diesel engine controls, and secondary load system - leverage the renewable resource to the fullest possible extent.

Construction was managed by STG, Inc., which also provided much of the heavy construction equipment and skilled labor employed on the job. Local skilled and unskilled labor was also employed. Northern Power Systems manufactured the turbines and supplied the towers, and provided some installation and commissioning assistance. Engineering of the foundations and secondary load system was accomplished by Coffman Engineers, and additional system engineering was provided by AVEC staff.

**Funding, Costs and Cost Containment** - Funding was provided by Denali Commission grants to AVEC, and matching cash contributions from AVEC. Funding and costs are as follows:

	Federal portion of award	AVEC match portion	Total All Sources
DC award 0049-DC-2002-I2	\$ 174,926	\$ 0	\$ 174,926
DC award 349-07	\$ 3,036,000	\$ 356,770	\$ 3,392,770
<b>Total Funding (Budget)</b>	<b>\$ 3,210,926</b>	<b>\$ 356,770</b>	<b>\$ 3,567,696</b>
DC award 0049-DC-2002-I2	\$ 174,926	\$ 0	\$ 174,926
DC award 349-07	\$ 2,919,387	\$ 343,067	\$ 3,262,454
<b>Total Actual Costs</b>	<b>\$ 3,094,313</b>	<b>\$ 343,067</b>	<b>\$ 3,437,380</b>
Funding in excess of costs	\$ 116,613	\$ 13,703	\$ 130,316

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Total funding of \$3,567,696 exceeds total actual costs of \$3,437,380 by \$130,316. Of this amount, federal funds in the amount of \$116,613 are now available for de-obligation on award 349-07 on this project.

Design Generating Capacity	300 kW
Constructed Generating Capacity	300 kW
The completed, installed generating capacity is equal to the design capacity.	

Initial budgeted project cost	\$11,892 per kW.
Final project constructed cost	\$11,458 per kW.
Denali Commission benchmark range	N/A

Currently, no cost containment benchmarks have been established by the Denali Commission for projects of this type.

**Problems Encountered/Lessons Learned** - Poor soil conditions in the vicinity of Gambell, including at the project site - unstable rounded cobble gravel with little to no binding qualities - created substantial engineering challenges to develop a foundation design that would work under these conditions. The chosen concept was to build massive concrete ballast for each tower to counter wind and overturning forces.

During construction, a village resident living in an undocumented structure on an unrecorded parcel close to the project site, objected to the proximity of the turbines to his home. The community requested the project layout be reconfigured to accommodate his objections. Construction of foundations was delayed from fall 2008 to spring 2009 while a new site was surveyed and replatted and permits were updated. Consequently, additional costs were incurred for construction equipment rental, field labor, project management, site-related efforts and a slightly longer distribution line. This experience led to greater community relations efforts on concurrent and subsequent projects to ensure that such conflicts are resolved prior to construction.

The original concept was to build an amalgamated project, combining three projects: tank farm (Denali project 31A), power plant (project 31D) and this wind farm (project 31B). This concept had to be abandoned due to non-concurrent funding availability, and considerations on wind turbine type and location. The long actual project schedule required separate mobilizations of equipment and materials for the three projects. As with other AVEC capital projects in rural Alaska, challenging work conditions and remote locations add to the cost of completing the project. This site, on St. Lawrence Island, only 38 miles from the Russian mainland, is one of the more distant sites to mobilize to and support.

**Conclusions** - The project partners overcame substantial technical challenges in the design phase, and considerable environmental challenges in the construction phase. Despite these obstacles, the wind turbine installation was completed with a high level of quality and craftsmanship, and within budget. The project as constructed meets all current regulations and codes. It meets Denali Commission goals to include alternative energy into the scope of AVEC projects where practical.